MODEL 600M

RUGGEDIZED MicroVAX II

TECHNICAL INFORMATION

CODAR
TECHNOLOGY
INC.

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130-0008 Revision A 1 December 1987
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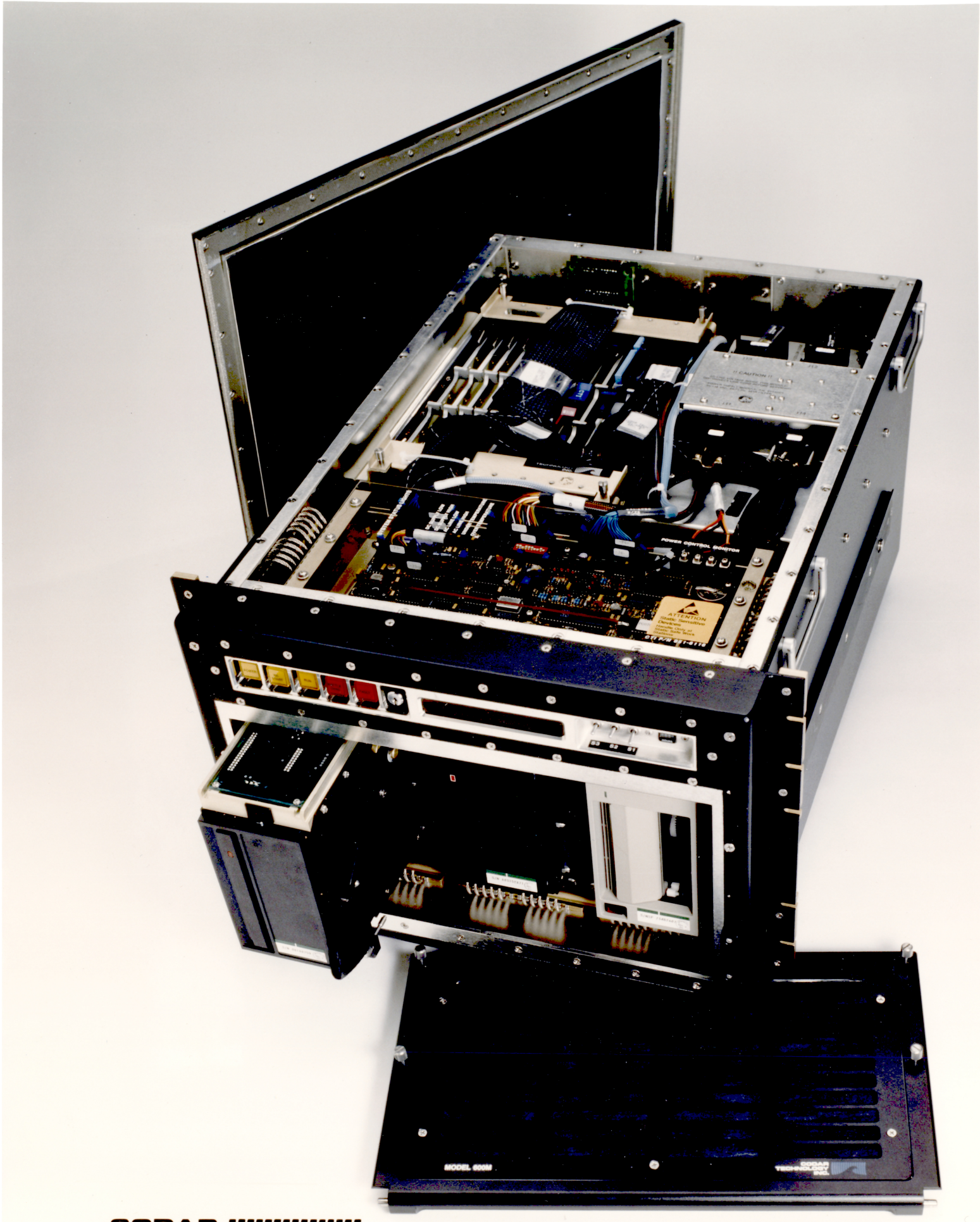

CODAR TECHNOLOGY INC.

Model 600M

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600M MicroVAX II
TECHNICAL INFORMATION

1.0 INTRODUCTION

This document provides detailed technical information on the Codar Technology Model 600M ruggedized MicroVAX II computer. Information is also provided on Codar's technical capabilities in the area of ruggedized computer systems.

The 600M is the first ruggedized MicroVAX to provide the user with a choice of either four fixed or three removable internal shock mounted peripherals, 14 back-plane slots and 1100 watts of DC power in a 24" deep rack mount enclosure. It also offers certified EMI, shock and vibration test data to MIL-STDS-461B and 810D. Radiated and conducted emissions are essentially nonexistent from 10 khz to 12 ghz allowing the 600M to meet all NACSIM 5100A requirements.

We recognize that many programs can not use off the shelf hardware. As a result, we can provide a variety of modifications to the 600M with low NRE charges and quick delivery. In fact, our company specializes in this area as witnessed by our in house production machine shop and EMI, Temperature, Shock and Vibration test facilities.

An example of our custom capability is the Model 600M-22 which was designed for an Air Force program. This MicroVAX II system provides a 22 quad slot backplane with 0.65" module spacing and four internal shock mounted peripherals. Full military power supplies are provided in a separate chassis.

A similar system with 44 slots and two 140 Mbyte shock mounted disk drives has been delivered to McDonnell Douglas. The Army ASAS MicroVAX computer (PAWS) uses a backplane and QPL power control module designed and produced by Codar. The Air Force IITS system (GE Prime) also uses a slightly modified 600M.

The Army TACAMS system (LTV Prime, Army MICOM customer) uses a special 600M with dual KA620 processors in a single backplane along with Codar supplied TACFIRE modems and a KG31 crypto hardware/software interface. Codar also developed several custom hardware/software communications interfaces for the TACMS 600M Central Data Processing Unit. The TACMS program is rather unique in that it represents a full tactical C3 deployment in military tracked vehicles (M577) of ruggedized MicroVAX systems .

Much of our expertise is derived from seven years of corporate experience as a major manufacturer of Q-Bus modules, interfaces, backplanes and chassis. In fact, we delivered our first ruggedized Q-Bus computer in 1980 which makes us the oldest hardware manufacturer in the business by several years.

Our capabilities are backed up by a full MIL-I-45208A approved QA program which has been certified by numerous prime contractors including Martin Marietta, GE, Harris and LTV. Our devotion to quality shows. As of 12/1/87 we have an estimated 153,000 hours of customer field operations without a single 600M chassis failure. Peripheral failures have been limited to the loss of two disk drives.

Much of our success is the result of a strong corporate commitment to stringent quality control in both manufacturing and engineering design. We are also heavily committed to ESS (Environmental Stress Screening) on all production systems. Our in-house facilities include walk-in temperature cycling rooms and programmable vibration test tables.

SECTION 1.1 600M CONFIGURATIONS

The 600M is a mature product which has evolved through numerous military programs. As a result, there are a variety of minor configuration options and differences. This section will try and place these differences in perspective.

1. **CHASSIS DEPTH:** Our standard depth is 24". A 22" version is also available on special order. The only difference is the amount of available internal displacement available for dissipation of shock energy. We recommend the standard 24" version for all mobile or shelter applications with significant low frequency shock energy.

2. **POWER SUPPLIES:** The 600M is normally supplied with separate internal +12 volt and +5 volt ruggedized power supplies. Other options, including MIL-SPEC units and 28 VDC input systems are discussed in section 4.1.

3. **OPERATING TEMPERATURE RANGE:** The 600M is designed for operation from 0 C to 50 C. Operation to -20 C (or lower) is possible using the low temperature option. This is discussed briefly in sections 5.2 and 10.0.

4. **BACKPLANES:** The 600M is available with 14, 16 or 22 slot backplanes. The standard unit is 14 slots with 0.6" board-to-board spacing. The 16 slot backplane is available on special order. The 22 slot backplane requires the use of an external rack mounted power supply. All backplanes can be split to support multiple independent CPUs.

5. **PAINT:** Each system is painted per your specified Federal Standard 595 color. Sample color chips of our stock colors are available on request. Our standard colors are DEC grey, Navy grey, Army green and a textured gloss black.

SECTION 1.2 TEST FACILITIES

Codar maintains extensive in house test facilities. These include low and high temperature testing, EMI radiated emissions and shock and vibration instrumentation. Additional testing is provided under contract by Ball Aerospace Corporation in Boulder, CO.

We can often provide quick in house test programs as required to verify your proposed design at the proposal stage. As an example, we measured temperature, shock & vibration levels inside an operational M577 vehicle at Ft. Sill, OK as part of the Army TACMS program. In many cases our capabilities could provide you with a competitive edge with your customer.

We are in the process of accumulating extensive test data on the performance of transit cases and disk drives under conditions of high shock and vibration. Additional data is being collected on the effect of extreme temperatures on computer peripherals in conjunction with the 600M. This information is available on request to qualified organizations.

Much of this testing is beyond the scope of normal ruggedized applications. However, we feel that it is important to quantify operational extremes along with the resulting effect on MTBF.

SECTION 2.0 DEC LICENSING

Codar Technology is an authorized Digital Equipment Corporation OEM and is licensed to resell MicroVAX II CPU modules (KA630-AA) in ruggedized systems under Digital Equipment Corporation agreement #80018918.

Under this agreement, DEC sells CTI the MicroVAX II module (KA630) for inclusion in the Model 600M. CTI can legally transfer this system including the KA630 and all DEC software directly to you or your customer. The resulting 600M system is also eligible for DEC field service plus any future software updates. Codar is also a DEC licensed systems level MicroVAX III, VAX BI 8250 and 8350 OEM.

These services are not legally available with DEC support from unlicensed manufacturers who obtain the MicroVAX II CPU module on the "Gray Market".

SECTION 3.0 MAINTENANCE AND REPAIR POLICY

DEC will presently maintain the 600M on a regional basis (level C support). The cost of maintenance is determined by the location, number of machines under contract and required level of support. Please contact CTI for additional information.

On smaller programs, Codar provides a return to CTI repair and maintenance program. Emergency replacement parts are available overnight by Federal Express. Codar can also provide onsite repair and maintenance using an in-house service organization.

Maintenance and repair are greatly simplified due to the modular design of the 600M and the low failure rate. In fact, the 600M consists of just five Line replaceable Units (LRU) to greatly reduce both MTTR and sparing requirements. Detailed maintenance procedures are included in the 600M user's manual. Demonstrated MTTR is 25 minutes or less.

Complete ILS and depot repair programs along with the associated documentation are available in the format required by your customer. We can also supply prefaulted modules for training and "Gold Kits" for field maintenance. Large program support can be arranged through the use of sub-contractors to Codar, including the largest 8A firm in the country.

Codar provides a two year limited warranty on the 600M chassis and one year limited warranty on all installed modules and peripherals not manufactured by Codar. Each new customer (or program) also receives two days of technical and maintenance training at our facility.

SECTION 4.0 POWER SUPPLIES

The 600M uses high efficiency switching-type power supplies. These units are designed to provide long life under high stress conditions. Due to the modular nature of the 600M, a variety of different supplies, including 28 volt DC input units, can be installed to meet specific program requirements.

Supplies are selected on the basis of reliability and capacity. We maintain an ongoing engineering effort for supply testing and evaluation. Once approved for production, supplies are subjected to long-term accelerated testing in an effort to uncover any potential reliability problems. These procedures are effective - we have not had a single 600M power supply failure in the field.

Each production supply undergoes 72 hours of full load power on/off cycling at 3 second intervals. Following installation in the 600M, the supplies are temperature cycled while operational for an additional 72 hours as part of the system testing. All testing is performed and documented in accordance with our MIL-I-45208A QA program.

The Model 600M uses two high-reliability internally mounted ruggedized supplies. The first unit provides +5 volts at 72 amps and the second unit +12 volts at 15 amps. These units are modified by Codar to insure that our MTBF goals are met.

We can also install two high density 550 watt (1100 watts total) internal supplies which will provide up to 144 amps at +5 volts and up to 50 amps at +12 along with -12, -5 and +24 volt outputs.

In the high density configuration, one supply feeds even numbered backplane slots and the other supply the odd numbered slots using redundant wiring. This procedure eliminates problems encountered with direct paralleling of high current supplies. The +12 volt outputs are divided between the backplane and peripherals depending on system current requirements.

Power supply features include short circuit and over-voltage protection, automatic short circuit recovery, remote sense, input surge current limiting and automatic thermal shutdown. Ground benign MTBF per MIL-HDBK-217D is a minimum of 40,000 hours on each supply.

Standard input voltage range is 95 to 138 VAC, 47 to 440 hz. The supplies will actually work,if required, at less than 90 VAC.

SECTION 4.0 INTERNAL POWER SUPPLIES (Continued)

All supplies have passed (certified test data) MIL-STD-810D for 40 G shock, 8 G random and 4.5 G sinusoidal vibration, 20 to 2000 hz. MIL-STDS 1399, 704D and 5400E are met in conjunction with the 600M's solid state relay design (Patent Pending). Due to our modular design, other combinations of voltage and current can be provided. Please contact CTI concerning your specific requirements.

SECTION 4.1 INTERNAL MIL-SPEC POWER SUPPLIES

The 600M is available with internal full MIL-SPEC power supplies. These units are hermeticaly sealed full QPL designs. Separate 300 watt +5 volt (60 amps) and +12 volt (25 amp) supplies are used. Total available power is 600 watts.

Please contact CTI for additional technical and delivery information on these units and your specific program requirements.

SECTION 4.2 EXTERNAL POWER SUPPLIES

MIL-SPEC power supplies are also available installed in an external 5" rack-mounted chassis. This approach allows the Model 600M to retain internal mounting for up to four 5 1/4" peripherals while providing substantial DC power and a 22 quad-slot backplane.

These supplies are certified and tested to MIL-STD-810D, MIL- STD-1399, MIL-STD-704D, MIL-STD-461B, MIL-E-5400P and MIL-S-901C. Units are fully encapsulated in hermeticaly sealed containers. Total available power is 1000 watts consisting of +5 volts @ 100 amps and +12 volts @ 42 amps. The calculated MTBF under operating conditions of 50 C base plate temperature, maximum line voltage and full power output is 54,530 hours for a ground benign environment. Available options include enhanced reliability and 115/230 line voltage input.

This configuration is normally used when 22 quad-slots are required inside the basic computer. It has also been used with standard 14 quad-slot configurations when a quick disconnect power supply is required for maintenance reasons.

SECTION 4.3 EXTERNAL DC TO AC CONVERTER

We can provide an external high efficiency DC to AC converter for use with AC input versions of the 600M. This unit is designed to operate with standard military 28 volt DC power (MIL-STD-1275 vehicle power) and is supplied in a small EMI sealed transit case. It is used primarily to satisfy field operations or situations where both AC and DC power are required.

SECTION 4.4 DC POWER SUPPLIES

The 600M is available with 28 volt DC power supplies for use in vehicles. This is accomplished using combinations of up to six Vicor high frequency DC/DC converters mounted on machined heat sinks inside the power supply assembly.

Total available power is 1200 watts. Our typical configuration is +5 volts at 90 amps and +12 volts at 30 amps, with one spare module position for expansion. These systems will operate from 20 volts to 30 volts as required by MIL-STD-1275. A special high current version of our TEMPEST line filter is used with DC input systems.

SECTION 4.5 POWER SUPPLY NOISE

A major problem with switching power supplies is the generation of EMI or "switching noise". This problem is particularly insidious with high frequency switchers like the 1 Mhz Vicor units. Unfortunately, solving this problem is usually an after thought by the designer rather than a specific program goal, as at Codar.

We are quite proud of the fact that our systems are extremely quiet. This is due to our use of platted aluminum, huge ground planes, extensive shielding and RF bypassing, our own backplane design, custom EMI filters and years of experience designing RF hardware and radar systems.

We recently saw a "TEMPEST" system that had 0.4 volts of switching noise and general garbage on every circuit **including** the external I/O communications lines. This system would not pass FCC Class A emissions much less MIL-STD-461B or TEMPEST. (It was sold as a "TEMPEST" system.) This is unfortunately one of those subtle technical areas that is often over looked in the midst of the marketing sales hype. In our opinion it borders on fraud.

SECTION 4.6 POWER SUPPLY SUMMARY

The following is a summary of available power supplies:

1. Internal ruggedized commercial, separate +5 & +12, 540 watts total (standard AC input 600M configuration).

2. Internal ruggedized commercial, two 550 watt units (1100 watts total) with four separate outputs each (optional).

3. Internal QPL MIL-SPEC supplies, separate +5 & +12, 600 watts total available power (optional).

4. External MIL-SPEC supplies in a 5 1/4" chassis, one +5 and one +12 at 500 watts each (optional).

5. Internal 28 volt DC power supply with up to 1200 watts of capacity (standard on 28 VDC input 600M systems).

All power supplies are available with special crowbar circuits for use in radiation hardened applications (fast neutron & gamma). Please contact our director of security for additional information.

SECTION 5.0 SYSTEM COOLING

The 600M is cooled by three 110 CFM DC fans mounted on the rear panel. Air is pulled through a front panel removable air filter then over and around the disk drives. At this point, part of the air flow is pulled through the power supply assembly using one of the fans.

The remainder of the air is pulled through the backplane assembly using the remaining two fans in conjunction with ducting. Dual fans are used for backplane cooling to provide increased reliability and lower acoustic noise compared to a single large fan design. Service loops are provided on the fan wiring to simplify maintenance.

The air discharge area is relatively large - approximately 75 square inches. This insures low back pressure and more than adequate airflow while eliminating cooling "dead spots" inside the system.

SECTION 5.1 SYSTEM AIR FLOW CALCULATIONS

The 600M's cooling system has been designed to provide adequate air flow under worst case conditions with reasonable safety margins. This is an important consideration with the KA630-AA MicroVAX II and KA650 MicroVAX III CPUs due to high die temperatures on two of the chips (gate arrays).

The 600M is designed to provide a maximum system air temperature rise over ambient of 6° C with a worst case internal power dissipation of 678 watts. This insures that DEC modules rated at 55° C can operate at ambients up to 49° C. By minimizing temperature rise, system reliability is greatly increased.

The required system air volume in CFM is determined from the allowable temperature rise, a safety factor and the system back pressure. Back pressure is dependent on air intake size, filter characteristics and physical obstructions within the chassis. The 600M's design back pressure is equivalent to approximately 0.10" of water (air filter dependent). The required air flow for a 6° C rise is given by:

$$\text{AIR FLOW (CFM)} = \frac{1.76 \times 678 \text{ Watts}}{6^\circ \text{ C}} = 199 \text{ CFM}$$

SECTION 5.1 SYSTEM AIR FLOW (Continued)

This assumes a system power dissipation of 500 watts and 74% power supply efficiency (678 watts total internal dissipation). The 600M's fans can provide 360 CFM at zero back pressure and 285 CFM with a back pressure of 0.10", a 30% safety factor. Conversely, this says that at 285 CFM the system temperature rise will only be 4.2° C.

Assuming the power supplies are normally loaded to 70% of capacity, only 139 CFM is required for system cooling with a 6° C rise. If we allow a 10° C rise at 0.10", only 119 CFM is required. Alternately, for a 10° C rise the system back pressure can be increased to about .21" with the fans still providing the required 119 CFM total or 39.7 CFM each.

These calculations demonstrate that the Model 600M will provide minimal component temperature rise even under worst case conditions. This performance is obtained using three fans in conjunction with large air intake and discharge ports. We urge you to examine both the air intake and discharge areas on competing products.

SECTION 5.2 LOW TEMPERATURE OPTION

The 600M is available with a low temperature option which allows system operation down to an ambient of -20° C. This is achieved by switching the three main DC cooling fans from high to low to off at decreasing temperatures. A small DC fan in the power supply is used to circulate internal heated air through the chassis at low temperatures.

This option also provides for protection of removable disk drives which may have been stored externally at very low temperatures. This is accomplished by preventing application of + 12 volts to the drive if the drive temperature sensor indicates that the drive itself is below 0° C.

At low temperatures, the system is held in the reset mode. Once it warms up, the reset is released, the system boots and + 12 volts is applied to the disk drive motors.

SECTION 5.3 THERMAL ANALYSIS VERIFICATION

Substantial thermal testing has been performed on the 600M. This work has been performed in a heavily loaded system using multiple thermocouples under a variety of operating conditions and configurations. below is a brief summary of this testing:

TEST CONFIGURATION: TEMPEST 600M, AC power supply, two KA630 CPUs, two 8 Mbyte memory modules, four Simpact 1622S communication modules, two DEQNA Ethernet modules, Dilog DQ696 disk controller & one (or two - see below) 380 Mbyte Maxtor disk drives, TK50 tape controller & one TK50 drive plus quad bus grant cards in empty slots. Total module power dissipation was 322.62 watts. Total internal dissipation was 404 watts assuming 80% power supply efficiency.

WITH 1 TK50 & 1 DISK DRIVE	**TEMPERATURE**
Air Intake Temperature:	**21.4° C**
Air Discharge Temperature:	**23.9° C**
Heat Sink on KA630 CPU Chip (Slot #1):	**38.2° C**
Above CPU Chip but Front Door Off:	**36.5° C**
Heat Sink on KA630 CPU Chip (Slot #9):	**37.6° C**
KA630 Onboard Memory DRAM Chip:	**24.8° C**
Middle of Slot #6 Bus Grant Card:	**23.5° C**
Above Power Control Module:	**22.3° C**

WITH 1 TK50 & 2 DISK DRIVES	
Air Intake Temperature:	**21.4° C**
Middle Disk Drive HDA Inside Canister:	**27.1° C**
Heat Sink on KA630 CPU Chip (Slot #1):	**42.1° C**
Average Temperature Across All Backplane Boards:	**24.4° C**

SECTION 6.0 AC POWER CIRCUITRY

AC power is provided through a male 3 pin MIL-C-5015 circular connector with circuit breaker protection. A six-foot power cord with mating connector is provided. (A 38999 Series III connector is used on DC input systems.)

A hermeticaly sealed Airpax breaker is used which breaks both sides of the power line. The circuit breaker uses a magnetic/hydraulic design which eliminates temperature dependence on trip current as encountered in thermal breakers. Also eliminated is false tripping due to initial power supply surge currents. The circuit breaker can also be used to totally disconnect AC power from the chassis.

The AC input system is assembled on a fully shielded tray on the bottom of the power supply assembly. This shielding provides the excellent power line EMI isolation required for MIL-STD-461B and TEMPEST related applications.

The AC input is protected against transients with three high current MOVs (Metal Oxide Varistors). These devices provide both common and differential mode protection. AC power wiring punch-through, due to high voltage transients, is prevented by using thick-wall Teflon insulated wiring.

The above components, in conjunction with the line filter and solid state relay, are used to satisfy the applicable transient requirements of DOD-STD-1399 for ship systems and MIL-STD-704D for airborne applications.

SECTION 7.0 CONDUCTED EMI SUPPRESSION

AC line noise and transients are heavily attenuated using a proprietary multi-pole TEMPEST design line filter mounted directly to the floor pan in the shielded power input assembly. This filter provides a sharp low pass cutoff frequency of 2.4 Khz.

Due to the design of this filter, there are no measurable power line emissions as measured under MIL-STD-461B, A4, Method CE03 including a 45 MHz extension in the required upper frequency to 100 mhz. This filter also allows the 600M to pass CE01 at frequencies above 3 khz. A similar filter is used on DC input systems. Copies of our certified test data are available in the 600M EMI testing report.

The majority of off-the-shelf commercial line filters fail to provide attenuation of incoming transients, surges and high voltage noise. This failure is a result of using small inductors which quickly saturate under abnormal line conditions regardless of the filters cutoff frequency. The 600M's filter uses high current components which eliminate this problem.

The 600M's filter measures 10.5" by 3.5" by 2.0", an indication of the units performance particularly at low frequencies.

SECTION 8.0 RADIATED EMI SUPPRESSION

The 600M series was designed specifically with the intention of satisfying TEMPEST and MIL-STD-461B, A4 requirements. This objective, in conjunction with system cooling, was the primary criteria for the 600M's mechanical design.

The chassis sides and floor pan are formed from a single piece of plated 0.090" aluminum. All aluminum surfaces including the entire power supply assembly are plated with tin over nickel over copper. This process provides excellent electrical conductivity (reduced ground noise) on all mating surfaces while providing a compatible interface for the Monel metal EMI gaskets. Due to the characteristics of the tin surface, assemblies are essentially self gasketing when screwed together.

The AC line filter, solid state relay and protective circuitry are all mounted directly to the floor of the power supply assembly in a completely shielded compartment. AC power is bused through an internal bulkhead to the power supplies which are also in completely shielded compartments.

SECTION 8.0 RADIATED EMI (Continued)

AC (or DC) enters the system through a MS connector and military circuit breaker both of which are totally enclosed in a shielded dog house assembly. The dog house assembly is in turn bolted directly to the end of the line filter.

The top of the 600M is machined from solid aluminum plate with ribs for weight reduction and strength. The lid overlaps the sides of the chassis to provide an increased EMI path length. A Monel gasket with compression stops is used on the inside surface of the top. As mentioned, the lid is tin/nickel/copper plated.

A tin plated 0.5" thick honeycomb filter is used over the air discharge vent on the rear of the machine. While considerably more expensive than standard irridited aluminum honeycombs, the tin plated device provides a substantial increase in EMI suppression eliminating the problem of a favored axis..

The front door is machined from solid aluminum plate, tin/nickel/copper plated and equipped with a 0.5" tin plated honeycomb EMI filter. A special expanded Monel dust filter is used between the door surface and the honeycomb. The entire front door assembly seals to the front of the chassis using a Monel gasket in a machined groove.

The front panel switch/display assembly is machined from aluminum bar stock, tin/nickel/copper plated and equipped with a Monel EMI gasket installed in a machined groove.

Ground plane PC boards and EMI filters are used on the switches and display for additional EMI suppression. Partial magnetic shielding is provided by the Nickel plating. Shielded and filtered I/O connectors are used as required on the rear panel. A 1/4X20 brass stud on the rear panel is provided for system grounding.

The resulting system passes MIL-STD-461B, CE03 and RE02 with virtually no measurable emissions. EMI testing was performed and certified by Ball Aerospace Systems Division in Boulder, CO. Our complete EMI test report is available on request.

The 600M meets the requirements of NACSIM 5100A without modification or additional charges. Additional information along with classified test data is available to qualified organizations. Please contact our director of security. The 600M is not on the PPL due to the endless possible I/O configurations.

SECTION 9.0 SHOCK AND VIBRATION TESTING

The Model 600M is designed to meet the following requirements of MIL-STD-810D: Low Pressure 500.2, High Temperature 501.2, Low Temperature 502.2, Temperature Shock 503.2, Solar Radiation 505.2, Humidity 507.2, Fungus 508.3, Vibration 514.3, Acoustic Noise 515.3 and Shock 516.3. Also satisfied are applicable vibration requirements of MIL-STD-167-1. Encapsulated military power supplies meet the hammer test requirements of MIL-S-901C.

Information and actual data on our certified shock and vibration testing is available in a separate report. In summary, a complete system has been tested operationally on the X, Y and Z axis without disk errors at 15 Gs 11 ms and with recoverable disk errors under shock of 30 Gs 11 ms. The 600M also passed the tracked vehicle 7.9 G RMS (42 G peak) random vibration test sequence. The resonant frequency of the Aeroflex helical wire shock mounted peripheral system was verified to be between 6 and 8 hz using sinusoidal vibration sweeps. This low resonant frequency provides excellent shock and vibration attenuation.

The 600M can be further "tailored" toward either low frequency shock as experienced in tracked vehicle installations or high frequency vibration as found in jet aircraft. This is accomplished by using Aeroflex mounts with different resonant frequencies and "K" constants. Our standard mounts are a general compromise and suitable for all but the most severe extremes.

In additional testing, the 600M has passed the 30" corner drop test and loose cargo test while mounted in an ECS transit case. The 600M with disk drives installed has also passed, without any damage, a 100 G transient drop test and the MIL-STD-810D 4" bench handling drop test both operating and non-operating.

SECTION 10.0 OPERATING TEMPERATURE

The Model 600M chassis is designed, tested and certified for operation from -20° C to +65° C. However, DEC supplied modules and/or peripherals typically limit the usable temperature range to 0° C to +50° C.

At below 0° C, most Winchester drives will shut down due to either high +12 current consumption or the inability to calibrate on track 0. In general, DEC's TK50 is the weak link at low temperatures. The TK50 will however operate down to 0° C ambient due to internal heat generation in the 600M.

As mentioned previously, the lower ambient temperature range in the 600M is effectively extended to 0° C using a two speed fan system controlled by a solid state temperature sensor. This system also reduces acoustical noise as the fans are on high speed only when required.

Low temperature operation is handled by an optional low temperature package. This option provides a special bus grant board with heating resistors and a solid state temperature control. These modules are used to generate additional internal heat for low temperature operations.

Temperature sensors are also supplied in side the disk drives which prevent application of the motor +12 volts if the drive temperature is below 0° C (A problem if the drive is stored outside in the cold and then placed in a warm machine).

Please contact our Military System Division for additional information on extended temperature range operation.

SECTION 11.0 POWER FAIL AND SEQUENCING LOGIC

The Model 600M generates all required Q-Bus AC power failure detection and DC power supply OK signals. These signals are generated using a crystal controlled CMOS state sequencer which guarantees exact timing without the use of RC delays and their associated problems (Patent Pending).

RC delays are used by many companies, including DEC, to generate power sequencing signals. Our own field experience has shown that these designs, while low in cost, suffer from several major design problems. Power failures that fall within a certain timing window are not detected as the RC network does not fully discharge. The result is that the Q-Bus system fails to reboot following a short power failure or transient as commonly found under tactical field and MIL-STD-1275 power conditions.

Another problem is attributed to reduced power supply voltage on the computer due to brownouts (or generator surging) and slow AC line ramping (a problem when UPS systems are used). As an example, if a deep power line brownout reduces the +5 volt supplies output to +4 volts the CPU's micro-code will fail and/or disk drives may be corrupted.

As a result, when the power returns to normal, the CPU ignores all signals including the reboot switch (a transition on the Q-Bus DCOK line). The system is completely hung and can only be restarted by turning the power off and back on. Often the power fail circuit itself fails to work properly or generates spurious signals as it is subjected to the same out of tolerance voltages as the CPU.

Operation on generators poses another interesting problem. Due to the generators rather high output impedance, the top of the AC sine wave tends to be clipped off due to high system surge currents. This results in an apparent low line voltage which can result in erroneous power fails. The 600's power fail circuitry provides compensation for this problem.

SECTION 12.0 AC POWER CONTROL

A solid state AC relay is used as part of the Power Control Module (PCM) to control power to the system power supplies. This relay is, in turn, controlled by a low current CMOS control system which derives its power from a totally independent power supply. When this power control system senses either a high or low AC line voltage, AC power to the system power supplies is shut off.

This eliminates problems such as disk drive data corruption and CPU lockup which frequently occur when systems are forced to operate with an out-of-specification +5 volt supply due to a power line brownout. Another benefit of this design is that the system power supplies are protected from high line voltage fault conditions as encountered in field applications or in MIL-STD-704D.

A logic output is provided which can be used for sequencing AC power to external chassis and racks. The Model 600M's internal monitoring can often be used to eliminate the cost, space and weight of external system power control electronics. When a power-down sequence is initiated, the power remains off for one full second.

This insures that all hardware controlled by the power sequencing sees a clean power fail. This also eliminates problems that can arise from multiple power failures of short durations as encountered in a tactical environment. In particular, power supply component stress is considerably reduced. The AC line shutdown circuitry is overridden by the battle short switch.

The front panel power switch controls the system AC power via a solid state relay. This results in an increase in system reliability and safety as the line voltage is never broken by a mechanical switch, an important benefit in MIL-STD-810D Method 511.2 explosive environments.

The solid state relay is designed to turn on only at zero crossings of the AC line. This helps eliminate component stress, as the power supply input capacitors are allowed to charge while tracking the AC power sine wave. Random power turn-on can result in extremely high surge currents into the discharged capacitors despite soft turn-on circuitry in the supplies. EMI is also significantly reduced due to the zero crossing turn-on.

In the event the PCM does shut the main system power off, the cause can be determined by examining six internal LEDs (Low/High AC, DC, Temperature) which operate from the independent PCM power supply.

SECTION 13.0 Q-BUS BACKPLANE

The Model 600M provides 14 quad Q-Bus slots (16 on special order) using a shock isolated backplane design. Boards are spaced on 0.6" centers rather than the industry standard 0.5". (The optional 22 slot backplane provides 0.65" spacing.)This increased spacing greatly increases air flow which results in lower component temperatures and increased MTBF (both real & calculated) while helping to satisfy the requirements of MIL- STD-810D, Method 501.2 high temperature.

Three C-D slots are provided for use with the MicroVAX II CPU and memory boards. The MicroVAX II can be configured with up to 16 Mbytes of memory, the maximum allowed by DEC. MicroVAX III CPUs can also be installed.

The 0.125" thick multilayer backplane uses four layers with separate power and ground planes. The backplane is physically connected to the card cage at eight points to prevent flexing during board insertion or high shock conditions. Additional strength is also provided by two machined aluminum bars. Socketed bus terminators are provided in high-reliability machined pin sockets.

The use of controlled width PC traces over a solid ground plane results in an extremely low noise 120 ohm transmission line design, as required by DEC. This proprietary Codar Technology design eliminates what, in our experience, is the main source of system reliability problems - backplane noise. Additional information on this critical subject is available from our engineering department.

Power is connected to the backplane at opposite ends of the backplane using four pairs of power and ground wires to minimize voltage drop. As mentioned, even numbered slots are fed from one power supply and odd numbered slots from another in the 1100 watt configuration. Jumpers are provided on the backplane which allow the entire backplane to be driven from the standard single 550 watt supply.

Dual-wide boards are restrained relative to each other using between-board channels. Empty board slots are filled with special quad-wide bus grant cards with reinforcing bars and ejector ears. This retention system has been tested (and certified) with 7.9 G random vibration and 40 G X, Y and Z shock forces.

The 600M's backplane artwork is digitized and stored on magnetic tape. This allows us to provide quick turn around on custom modifications. A common modification is to provide two or three independent MicroVAX II (or III) "backplanes" on one physical 14 or 22 slot backplane. This approach can result in significant cost, size and weight reductions in mobile shelter installations. (A split backplane with dual KA620s was used on the Army TACAMS program.)

SECTION 14.0 FRONT PANEL CONTROLS

14.1 KEY LOCK SWITCH

This switch has three different positions. The first position, "OFF", is completely counter clockwise. In this position, the computer is turned off regardless of the rear circuit breaker or the front panel power switch.

The middle position, "RUN", passes control to the front panel switches assuming that the rear panel AC circuit breaker is in the on position. All front panel switches are now active including power on/off. This would be considered the "normal" position.

The third position, "LOCK", is completely clockwise. In this position all of the front panel switches are deactivated. However, control reverts to a set of default conditions; POWER ON and RUN. This is the "Power and go" mode as on application of AC line power (or after a power failure) the system will normally auto-boot into the run mode. This mode is useful if you do not want the system tampered with by others.

14.2 AC POWER SWITCH

This is a locking switch that controls system primary AC power. Depressing this switch turns on the AC power assuming the rear panel circuit breaker is in the "ON" position. A light in the switch is also illuminated, if DC power is within an acceptable range. Pressing the switch again turns the AC power off. This switch controls a solid state AC relay which in turn actually controls the AC power to the system power supplies.

14.3 BOOT (RESTART) SWITCH

This is a momentary contact switch. Depressing it causes the system to "reboot". This is accomplished by using the DEC technique of simulating a power failure using the backplane DCOK line.

14.4 RUN SWITCH

Depressing this locking switch to the in (on) position places the CPU in the run mode and illuminates its integral run light if the CPU is configured to enter the console program on power-up. If the CPU is set for auto-boot, the RUN/HALT switch will have no effect (DEC convention). In the out position, the run light goes out, the computer halts and the CPU normally reverts to DEC's console program.

14.5 BATTLE OVERRIDE SWITCH

This is a momentary switch with an internal LED indicator. The function of this switch is to disable the 600M's internal protection logic against problems such as low/high AC line voltage or high internal temperatures. When enabled, the switch's internal LED is on and the computer is in the battle override mode of operation.

It is normally armed only during critical tactical situations. It allows the computer to attempt to work under difficult environmental and power conditions. However, internal damage to the computer or peripherals may occur under these conditions. Damage to the computer due to operation in the battle override condition is not covered by the system's warranty. Depressing the switch in it self will not cause any system damage.

14.6 SYSTEM FAULT INDICATOR

This indicator is illuminated if the Power Control Module (PCM) has turned off primary AC power (via a solid state AC relay) due to a problem such as low/high AC line voltage or high internal temperatures. This light derives its power from an independent small power supply. Thus, it can be on even if the system primary AC power is off. (The rear panel circuit breaker must be "ON".)

The exact reason for the shutdown can be determined by examining the five LEDs on the internal Power Control Module.

SECTION 15.0 FRONT PANEL ALPHANUMERIC DISPLAY

A 16-digit alphanumeric microprocessor LED display is provided on the front panel for monitoring of system parameters. Using a toggle switch, the customer can select either a specific sensor or the auto-scan mode. In the auto-scan mode, the display sequences through the channels at a rate of one channel every two seconds.

Displayed parameters include; +5 volts, +12 volts, AC line voltage, backplane temperature (optional sensor board), intake air temperature, fan status and date and time via an internal CMOS calendar clock. A serial port is provided which allows all the microprocessor data to be read by the host MicroVAX II CPU using customer developed interrogation software.

The front panel display is controlled by the Power Control Module (PCM). The PCM contains a Z8 microprocessor which runs the 16 digit display. This technology is derived from a stand alone Q-Bus module we manufacture called the Model 170 Q-Monitor.

The Z8 microprocessor is capable of performing a large variety of functions in addition to those discussed in this document. As an example, unused analog and digital channels can be monitored, logged, time stamped and displayed on the front panel or read by the MicroVAX with customer developed software. You can also display messages on the display that were generated by the MicroVAX CPU.

Due to the large number of possible configurations, we have chosen to only implement the front panel display and date and time functions. Please contact us if you would like additional information concerning these "hidden" capabilities. We can also provide you with a copy of the Q-Monitor manual which will provide a good starting point concerning capabilities and programming requirements.

16.0 ELAPSED TIME METER

A hermetically sealed military meter is mounted on the front panel and shows total AC power up time with a maximum indication of 9,999 hours or about 14 months. It is non-resetable and will roll over to 0,000 hours and continue automatically after 9,999 hours. As an example, 11,500 hours will be displayed as 1500 due to the roll over which occurred at 9,999.

The elapsed time meter on a new system will normally show 100+ hours due to complete system testing prior to shipment. This is in addition to test time performed on the individual subassemblies.

SECTION 17.0 REAR PANEL CONFIGURATION

The 600M is available with two different rear panels:

1. **Custom I/O to your specifications.**

2. **Standard for developmental use.**

The 600M is normally supplied with the rear panel punched and silk screened to accept specific connectors as specified by you. We supply a blueprint of the rear panel to assist in this project. In order to simplify your development, we also offer a rear panel with knockouts for four standard DEC I/O panels plus a fifth oversize slotted panel for ribbon cable egress.

We can provide different rear panels, at nominal cost, as your program develops. You are not locked into the specific rear panel configuration as delivered with your system. Contact our customer service group for assistance.

The developmental rear panel is supplied with a 22 pin MIL-STD-38999 Series III connector and a filtered DB9 connector. The systems console is wired to both the DB9 and the 38999. A special 38999 cable with separate DB connectors (console & Z8) is supplied with each system. The remaining pins on the 38999 are used for analog and digital signals going to and from the Z8 microprocessor.

SECTION 18.0 LOW INSERTION FORCE CONNECTORS

The Q-Bus backplane is available on special order with low insertion force military bristle brush connectors (B3) installed in place of the standard DEC style edge connectors. We provide mating connectors which can be retrofitted, by CTI, to standard DEC style dual and quad modules. This combination provides the high reliability required in tactical applications. Please contact our Military Systems Division for additional information on these connectors.

SECTION 19.0 MicroVAX II CONFIGURATION PANEL

The MicroVAX II requires a special I/O panel which provides a diagnostic LED, baud rate selection and system configuration jumpers. These functions are built into the 600M's control electronics on the Power Control Module eliminating the requirement for DEC's rear panel assembly.

SECTION 20.0 REMOVABLE DISK DRIVES

The 600M is available with three removable disk drives. Each drive is mounted in a black anodized canister with a quick release MIL-SPEC connector and handle. This allows the disk drives to be removed frequently for maintenance or storage in a safe. The TK50 is also supplied in a removable canister to facilitate field maintenance.

As part of the low temperature option, each drive is equipped with an internal temperature sensor which will prevent the application of +12 volts to the drive motor at temperatures below 0 C. This eliminates the possibility of disk damage in units which have been stored at extremely cold temperatures outside the chassis.

SECTION 21.0 SYSTEM INTEGRATION

The 600M series chassis are available as stand-alone chassis or completely integrated and tested systems. Systems are manufactured, integrated and tested by our Military Systems Division (MSD) under a MIL-I-45208A quality program. Orders for more than eight systems are produced on independent production lines with facilities available for your QA and source inspection personal.

We can supply the 600M with any module or peripheral you require, integrated and tested. A typical MicroVAX II or III system will have a TK50 cartridge tape and one or two Winchester disk drives of up to 760 Mbytes each installed in removable canisters. (The 600M can handle a total of four fixed or three removable internal 5 1/4" peripherals.)

CTI can also provide special high reliability 4 or 8 Mbyte conformal coated ECC memory modules. Other options include any current DEC Q-Bus module, CTI TAC-FIRE or KG31 interfaces, array processors from Sky and Mercury, 1397 NTDS FAST and 1553B communication interfaces, HPIB (IEEE) interfaces, Ethernet interfaces, disk and tape controllers, IRIG B timing modules and embedded VT100 terminal boards.

Unless otherwise required by the contract, modules are subjected to 72 hours of stand alone power and temperature cycling plus 72 hours of system burn-in. Each system also goes through at least 15 minutes of vibration as part of our ESS program. This test procedure has proven excellent at eliminating infant mortality failures. Specific FAT programs can be developed to meet your program requirements.

SECTION 22.0 SYSTEM TESTING & QUALITY ASSURANCE

The following is a brief outline of our test procedures:

1. All power supplies are tested for 72 hours at full rated output. The AC input is turned on/off at three second intervals during test. Units are allowed to heat up to 40° C to 50° C.

2. All backplane modules are tested for 72 hours with three second power cycling. At the same time the module is temperature cycled between ambient and 45° C.

3. All assembled systems are tested operationally for at least 72 hours while running disk and tape diagnostics. Twenty four hours of this testing is performed at a 45° C ambient temperature. A walk-in -20° C to +50° C chamber is used for final testing.

4. On-line vibration testing is applied for at least 15 minutes.

All assemblies and modules are identified by serial numbers for future reference and QA purposes. All paperwork and documentation is handled in accordance with an approved MIL-I-45208A QA plan. Completed systems are supplied with a configuration audit and FAT, sample copies of which are available on request. Additional ESS testing per your CDRLs is available on request.

SECTION 23.0 SYSTEM DOCUMENTATION

The 600M is furnished with complete documentation including installation, operating and test procedures. This documentation meets the requirements of DOD-D-1000, level 1. Limited documentation meeting the requirements of DOD-D-1000 level 2 is available as an option. Level 3 documentation may be available as a separate contract item on certain devices but is highly discouraged due to cost and legal issues.

Complete documentation and manufacturing packages are presently escrowed for ten years in a bank vault in support of several large DoD programs. We also maintain an alternate production agreement with MSC corporation in Denver, CO. This unique arrangement provides additional long term production security.

SECTION 24.0 TEST DATA

The 600M has been extensively tested under MIL-STD-461B, 167-1, 5400E, 810C and 810D by Ball Aerospace Systems Division in Boulder, CO plus several of our DoD customers. Separate EMI, TEMPEST and Shock & Vibration test reports covering this testing are available from Codar on request.

All testing was witnessed and certified by representatives of the U.S. government or DoD primes. Many companies claim that they "design to" various MIL-STDS. At Codar, if we design to it we test to it - with independent certification.

SECTION 25.0 MIL-STANDARDS

The Model 600M is designed, tested and certified to applicable technical and quality requirements of the following standards:

MIL-STD-810D	MIL-STD-461B	DOD-STD-1399	MIL-STD-167-1
MIL-STD-704D	MIL-STD-5400E	MIL-E-16400	MIL-STD-454

Additional testing is available to meet specific project requirements. Please contact CTI regarding current status on testing and certification to other standards and/or specific methods.

SECTION 26.0 OPTION PRICING INFORMATION

Our price quotes on optional items such as peripherals and interfaces include the following items and services:

1. A one year warranty as compared to the standard 90 day warranty.

2. Custom machining of the rear panel for and installation of all required I/O connectors.

3. Custom rear panel silk screening of connector ID numbers.

4. Custom internal I/O cables and strain reliefs in support of the option or peripheral.

5. System integration and 72 hour testing of all options plus a FAT.

6. Documentation of serial numbers, addresses and vectors plus a configuration audit.

7. Integration of the option or peripheral into the operating system.

8. Mounting and wiring of disk drives into removable canisters.

SECTION 27.0 TEMPEST SYSTEMS

The 600M is not listed on the ITP PPL due to the large number of different configurations. However, the 600M has been tested and shown to meet all requirements of NACSIM 5100A and is presently being used on numerous TEMPEST programs. Your specific configuration can be placed on the PPL if required (very expensive).

Codar will be glad to discuss general issues regarding a TEMPEST program. In general, the burden of technical problems (and new testing) will fall on your specified I/O cable systems external to the 600M. Codar will guarantee the TEMPEST capability of the 600M itself.

We can provided detailed test data and analysis on this subject for use either by you or your government customer. Please have your security office contact our director of security regarding a visit request or other procedures related to transmission of the applicable COMSEC documents. We find it interesting that other companies claim to provide TEMPEST MicroVAX systems when they have neither a facility clearance or the NACSIM 5100A documents.

SECTION 28.0 MAINTENANCE AND "BIT"

The 600M is designed for easy maintenance through the use of five LRU assemblies and interconnecting cables. These units are:

1. Power supply assembly.
2. Card cage and backplane assembly.
3. Front panel display and control assembly.
4. Disk assembly with power control module.
5. Rear panel fan assembly.

Each **LRU** is available for purchase as part of your **ILS** program. Fault isolation is provided to the **LRU** level as discussed in other sections of this document. We can also provide pre-faulted modules for training programs. **MTTR** at the **LRU** level is less than 30 minutes.

Extensive **BIT** (Built In Testing) is provided in the 600M. The major components are the MicroVAX diagnostic display, the six LED power control module fault displays and the front panel 16 digit alpha numeric maintenance display system all of which are discussed in detail in previous sections of this document.

SECTION 29.0 RELIABILITY

The 600M has a 21,000 hour MTBF design goal which we believe to be realistic in most ground benign environments. As of 12/1/87 we have accumulated 153,000 hours of operational time with no 600M chassis field failures of any type (two disk drives have failed due to operation by the customer without our air filters). Our average time per machine is about 4150 hours. With no failures, it is obviously difficult to derive MTBF figures.

The calculated MIL-HDBK-217D MTBF is about 1200 hours for a typical configuration. We have seen some calculations go as low as 600 hours. The obvious conclusion is that the handbook calculations understate the actual system reliability by about a factor of ten. We are quite willing to work with your proposal team on preparing a RFP or IFB reliability response.

SECTION 30.0 WARRANTY

Our standard warranty is 90 days on all items. If your invoice is payed in 30 days or less, we extend the warranty to 2 years on the 600M and 1 year on all standard catalog modules and peripherals sold and installed by Codar Technology.

Codar will not assume responsibility for system problems unless all internal peripherals and modules are supplied by us. Any exceptions to this policy must be agreed to in writing prior to contract acceptance. Installation of "Gray Market" CPUs or software purchased from non DEC authorized suppliers will invalidate our warranty.

Special purpose modules, purchased at the customer's request, are not covered under the CTI warranty. Specific details are provided in our written warranty, a copy of which is available on request. **NOTE:** CTI manufactured products including systems and modules are not authorized for use in nuclear installations or life support systems.

The 600M's limited warranty is described in detail in the systems manual. Individual copies of the warranty are available on request. Specific warranties can also be developed to meet your program requirements.

SECTION 31.0 EXPORT CONTROL

The Model 600M and MicroVAX II are controlled commodities which require export licenses for destinations other than the U.S. or Canada. CTI will not ship systems to brokers or agents.

All shipments must be made directly to a government agency, a known end user or a Department of Defense Prime Contractor or a NATO government. CTI reserves the right to refuse any sale which it does not consider to be in the national interest.

SECTION 31.0 DATA RIGHTS

The 600M was developed without the use of government funds. As a result, we will release only limited data rights.

APPENDIX A

TECHNICAL SPECIFICATIONS

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MODEL 600M TECHNICAL SPECIFICATIONS

TEMPERATURE:	
COMPLETE SYSTEM	0° C to +50° C Ambient.
LOW TEMP. OPTION	-20° C to +50° C Complete System Including Disk.
CHASSIS ELECTRONICS	-20° C to +65° C Standard; Extended Range Available.
NONOPERATING	-40° C to +72° C MIL-STD-810D Methods 501.2 and 502.2.
THERMAL SHOCK	MIL-STD-810D, Method 503.2.
PROTECTION	Auto-Shutdown at 0° C and 50° C (Adjustable). Power Supply and Ambient Temperature Sensors (Optional External & Backplane).
COOLING SYSTEM	Three 110 CFM DC Fans, Front Air Intake, Rear Discharge. Speed Control on Low Temperature Option.
TEMP. GRADIENT	6° C Max. (4° C Typical) Exhaust Temperature Rise Relative to Input Air Temperature. Detailed Thermal Analysis & Data on Request.
AIR FILTERS	Front Panel Mounted Removable Air Filter. Various Designs Cover a Variety of Different Operating Environments to 1 Micron.
HUMIDITY	5% to 95% non-condensing. MIL-STD-810D, Method 507.2
ALTITUDE	Sea level to 15,000 Ft. Operating (Disk Drives - 10,000 Ft.); 50,000 Ft. storage. MIL-STD-810D, Method 500.2
VIBRATION:	
SINE	1.5 G's 5 to 20 Hz.
SINE	2 G's, 20 to 2000 Hz, 5 G's 50 to 2000 Hz (No Damage).
RANDOM	7.9 G's RMS (42 G Peak), 20 to 2000 Hz (No Damage). MIL-STD-167-1 and MIL-STD-810D, Method 514.3.
RESONANCE	6 to 8 Hz on Disk Tray Depending on Axis with Isolator Q=3.
TEST AXIS	Tested on X, Y and Z.

MODEL 600M TECHNICAL SPECIFICATIONS

SHOCK:	
OPERATING #1	15 G's 11 ms with Disk Drives (no read or write errors on disk drives)
OPERATING #2	20 G's Operating with Soft Disk Errors only - No Disk Drive Damage.
NONOPERATING	40 G's 11 ms. MIL-STD-810D, Method 516.3, Procedure I.
TRANSIENT	Passes 100 G Shock Impulse on Drop Test Without Damage.
BENCH HANDLING	Passes 810D Bench Handling Both Operating and Nonoperating.
DROP TEST	30" on Each Corner in ECS Transit Case - No Damage.
LOOSE CARGO	Passes in ECS Transit Case - No Damage.
SHOCK MOUNTING	Stainless Steel Helical Shock Mounts (Aeroflex) on Peripherals & Power Control Electronics. Shock Isolated Backplane Design.
RAD HARDENING	Gamma & Fast Neutron - Contact CTI.
NUCLEAR EMP	Contact CTI.
PHYSICAL SIZE	17" Wide X 12.25" High X 23.5" Deep (19" RETMA Rack Mount). Depth Consists of 23.5" Behind Rack Flange and 2.5" In Front. 22" Depth Available on Special Order.
WEIGHT	70 Pounds For 600M Chassis Plus 8 Pounds per Disk Drive plus Approximately 1 Pound per Quad Module. "Lite" Model Available.
ACOUSTIC NOISE	48 Db at 1 Meter.
POWER:	
INPUT VOLTAGE	115 VAC Standard (95 to 138 VAC), 220 VAC (180 to 264 VAC). 28 VDC Input (20 VDC to 30VDC), MIL-STD-1275 Vehicle Power.
LINE FREQUENCY	47 Hz to 440 Hz. 400 Hertz FAT on Request.
POWER CONTROL	Solid State AC Relay Plus Independent Power Control System.
BROWNOUT	Auto System Shutdown Below 95 VAC or Above 138 VAC. Low/High Trip Points are Adjustable Between 85 and 140 VAC.

MODEL 600M TECHNICAL SPECIFICATIONS

POWER INPUT	Circular MIL-C-5015 Connector, Airpax Circuit Breaker Protected. Sealed Doghouse for TEMPEST and EMP Isolation.
Q-BUS BACKPLANE	14 X 4, 0.6" Board Spacing, 3 C-D Slots Standard. Four-Layer Low-Noise Design with Solid Power & Ground Planes. Split Multiple CPU Backplanes Available (6/8 Split Standard - Others Optional).
OPTIONAL CPU's	KA620, KA630, KA650, VAX8250, VAX 8350 11/73, or 11/83. (Please Contact CTI Concerning VAX 8250 & 8350 Systems.)
PERIPHERAL DEVICES	MSCP Disk to 760 Mbytes per Drive, TK Tape & RX50 Diskette.
PERIPHERAL CAPACITY	Three Removable 5 1/4" Peripheral Devices in Canisters. TK50 is Installed in a Canister to Facilitate Field Maintenance & MTTR.
DISK CANISTERS	Quick Release Design with Installation Lock and Carrying Handle, Black Anodize Finish. Full MIL-SPEC I/O and Power Connector.
POWER SUPPLIES	540 Watts: +5 Volts @ 72 Amps, +12 Volts @ 15 Amps. 1100 Watts optional. Shock & Vibration to MIL-STD-810D (40 G's). Internal EMI Filters. All Outputs are Protected Against Both Over-voltage & Over-current. DC Input Supplies to 900 Watts.
FRONT PANEL:	
CONTROLS	AC Power, System Restart, System Run/Halt, Battle Short, System Power Keylock
INDICATORS	Power, Restart, Battle Override, System Fault, Elapsed Time Meter.
INT. INDICATORS	LEDs for DC-Lo, DC-Hi, AC-Lo, AC-Hi & Temperature Low/High.
SYSTEM MONITOR	16 Digit Alphanumeric LED Display Monitors 8 Analog Sensor and Power Channels. Manual or Auto-Scan Channel Selection, Serial I/O Port allows DEC CPU to Read Sensor Data or Write Display.
SENSOR OVERRIDES	Front Panel Battle Short Switch. Overrides High/Low Temperature, AC Line & DC Power Supply Voltage Sensors.

MODEL 600M TECHNICAL SPECIFICATIONS

EMI:

SUPPRESSION	MIL-STD-461B CE03 & RE02, A4. Meets Requirements of NACSIM 5100A. Consult CTI for Test Data.
TEMPEST	Passes NACSIM 5100A - Contact CTI.
TRANSIENTS	Common & Differential Mode MOV's plus High Attenuation Line Filter. Reverse Polarity Protection on DC Systems. Auto Shutdown on High Line Voltage. Meets MIL-STD's 1399 & 704D.
GASKETS	Installed in Machined Groves on Front Door and Display. Lid uses a Flat Gasket in Machined Double Lip Channel. Compression Stops are Used On All Flat Gaskets and EMI Air Filters.
AIR FILTERS	1/2" Tin Platted Honeycomb EMI Filters on Front & Rear Openings.
SYSTEM WIRING	Teflon Wiring; no PVC. Sheathing used on all Cables per MS-454.
CUSTOMER I/O	Removable Rear Panel DEC Style I/O Plates or Custom Layout for up to 26 MS Style Connectors. MIL-STD-38999 Series III Standard.

MECHANICAL:

CONSTRUCTION	0.090" Aluminum Main Body. Machined Door, Lid & Front Display.
HARDWARE	Stainless Steel with Chemical Thread Locking (Loctite). Captive Fastening Connectors and/or Stainless Steel Lock Washers
FINISH	Tin/Nickel/Copper Plate on Aluminum; Two-part Urethane Paint to FED-STD-595 Colors. DEC Grey, Black and Army Green Standard.
COVER RELEASE	Top - Stainless Steel Screws; Front Door - Stainless Thumb Screws.
RELIABILITY TESTING	72 Hours of Power & Temperature Cycling on Chassis, Peripherals and all Modules. ESS Production Vibration and Temperature Cycling (-20° C to +50° C) Using In-house CTI Test Facilities.
QUAL TESTING	CTI Maintains In-house Shock, Vibration, Temperature and EMI Test Instrumentation Systems for Program & Developmental Use.

MODEL 600M TECHNICAL SPECIFICATIONS

MTTR	20 Minutes at the Module Level (I/O, Backplane and Power Supply). The 600M is Composed of Five LRUs for ease of Maintenance.
MTBF	Model 600M Chassis: 21,000 Hour Ground Benign Design Goal. Actual Production System Field Reliability Data on Request.
BITE	The 600M Provides Extensive Built in Testing Utilizing the 16 Digit Diagnostic Display, MicroVAX Self Test and System Fault LEDs.
DIAGNOSTICS	CTI Can Provide an Optional Proprietary Menu Driven MicroVAX Diagnostic Package. New Modules can be Added to Cover Your Proprietary Interface Designs.
QUALITY CONTROL	CTI Has Been Certified to MIL-I-45208A by Numerous DOD Primes. All Systems are Produced to the Workmanship Requirements of MIL-STD-454. Quality is Maintained through the use of In-house ESS.
DATA RIGHTS	The 600M was not Developed with Government Funds. As a Result, we will Grant only Limited Data rights. CTI has Licensed a Second Source to Insure Long Term Production.
DOCUMENTATION	Standard Documentation is Level 1 as Supplied by the Various System Suppliers. Level 2 Documentation is Available on Some Items at Additional Cost. Please Contact CTI Regarding Level 3 Documentation Requirements.
MANUALS	A Detailed User's Guide and Maintenance Manual is included with Each 600M. All 3rd Party Manuals (Disk Drives, etc.) are also Supplied along with Certificates of Compliance.
TRAINING	Each Customer or Program Receives Two Days of Training at CTI.
ILS	Complete ILS Programs are Available. Contact CTI for Information.
WARRANTY	90 Days, Extended to 2 years on 600M for Prompt Payment. Return to CTI, Parts and Labor included. One year on CTI Supplied 3rd Party Items (Disk etc.). Damage caused by combat or exposure to conditions beyond quoted specifications voids warranty.

NOTE: **Technical specifications are subject to change without notice.**
Export controls apply to this product - US & NATO Sales Only.

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